CHANNEL UNITS

SINGLE-ENDED TRANSMISSION TESTS

This Section provides procedures for performing single-ended transmission tests on D448 channel units.

This Section has been reissued to clarify ATAU test procedures and add information on ETS-4 testing.

WARNING: This equipment contains static-sensitive (CMOS) devices. Section ITTR-18-599 contains handling instructions for CMOS-equipped units.

The procedures in this Section should be performed after options have been selected on the channel units and the channel units have been installed in the multiplex shelf. Refer to Section ITTR-18-440 and/or ITTR-18-441 for option selection and installation procedures for the channel units.

The recommended method of testing, using the automated test and alignment unit (ATAU), 628450, is presented in Chart 1. If an ATAU is unavailable, the tests may be performed using standard test equipment with the terminal looped, as described in Chart 2.

Performing the tests contained in Chart 1 is not required by ITT, either for initial lineup or channel reassignment; however, it is recommended that these tests be performed to satisfy local practices or requirements on initial installation as follows:

Recommended Tests: Signaling (SIG), VF Level (LEV), Signal-To-Distortion (S/D), Idle Channel Noise (ICN)
Optional Tests: Tracking (TRK), Balance (BAL)

Channel unit transmit and receive voice frequency (VF) levels are set at the factory prior to shipment. If the office wiring loss (OWL) and nominal levels are known, the prescription level adjustments make level testing optional. The channel units are shipped with the nominal transmit and receive VF levels given in Table A.

TABLE A

FACTORY-SET CHANNEL UNIT LEVELS

CHANNEL UNIT TYPE	TRANSMIT LEVEL	RECEIVE LEVEL
2-Wire	0.0 ± 0.25 dBm	− 3.0 ± 0.25 dBm
4-Wire	− 16.0 ± 0.25 dBm	+ 7.0 ± 0.25 dBm

If the far-end terminal is an ITT T324 (or equivalent without prescription level adjustments) and has not been previously adjusted, single-ended/looped (at T324 end) or end-to-end level tests should be performed. Refer to Section ITTR-18-445 for procedures for performing end-to-end tests on the D448 multiplex terminal.

If trouble occurs while performing any of these tests, refer to the appropriate Section listed in Table B for trouble location procedures.

TABLE B

TROUBLE LOCATION PROCEDURES

TITLE	SECTION NO.
Mode 1 Alarm Trouble Location	ITTR-18-531
Mode 2 Alarm Trouble Location	ITTR-18-532
Mode 3 Alarm Trouble Location	ITTR-18-533
Non-Alarm Transmission and Signaling Trouble Location	ITTR-18-543

CHART **PAGE**

1—Single-Ended Testing Using the ATAU 2

2—Looped Testing Using Standard Test Equipment 9

CHART 1

SINGLE-ENDED TESTING USING THE ATAU

APPARATUS:

1—ATAU, 628450

STEP	PROCEDURE
	TEST SETUP
	Note 1: During initial testing, terminal must be end-to-end operational with no alarms or looped at the line interface (LI-) unit (LI- loop).
	Note 2: If multiplex shelf, 628001 or 628005, is being used, proceed to Step 2. If multiplex shelf, 628003, 628008, 628011, 628013, 628015, or 628018, is being used, proceed to Step 1.
1	Install test interface unit (TIU) in appropriate connector (common equipment mounting section); J6C of 23-inch shelf or J10C of 19-inch shelf.
2	Plug the ATAU power cord into the socket on the bottom of the case. Plug the other end of the power cord into a commercial 115-Vac outlet.
3	Place the POWER switch in the on position.
	Note: Various LEDs and the readouts will flash for several seconds following application of power to the ATAU. This is normal and indicates that the ATAU is going through a self-test. If any TEST SELECT LED remains flashing after the ATAU self test is complete, the associated TEST SELECT button should not be pressed. You may use all other test functions on the ATAU. At your earliest convenience, return the ATAU to ITT for repair (refer to Section ITTR-18-599).

CHART 1 (Cont)

STEP	PROCEDURE
4	Make the required test connections between the ATAU and the channel unit under test (CUUT) and the ATAU and the TIU (Fig. 1).
	Note: ETS-4 channel unit has two splitting card jacks. The lower jack, J2, must be used for VF access by the ATAU.
5	Operate the DIGROUP A/B switch to select the digroup associated with the CUUT.
6	Operate the SELECT – / + switch to select the CUUT.
	Requirement: The CHANNEL display should indicate the number of the CUUT.
7	Press the TEST SELECT buttons corresponding to the tests to be performed.
8	Press the TERMINATION AUTO button.
	Note 1: If the signaling (SIG) test has not been chosen, select the TERMINATION button corresponding to the CUUT type and impedance instead of the AUTO button. If the TERMINATION AUTO button is pressed without SIG, all TEST SELECT LEDs will flash to indicate an improper test setup.
	Note 2: The testing may be performed in either an automated or manual mode. For automated testing, proceed to the AUTOMATED TESTING part of this chart (immediately following). For manual testing, proceed to the MANUAL TESTING part of this chart (Step 11).
	AUTOMATED TESTING
	Note 1: When a channel unit fails to meet the test failure limits (TFL) for any test, the test sequence is halted and the LED corresponding to that test flashes. In any VF test, the failed result is displayed on the LEVEL display. The sequence is continued by pressing the STEP button. Pressing the START button restarts the entire test sequence at the beginning. To determine the exact test step failed, perform the failed test using manual testing.
	Note 2: For TFLs for the automated testing, refer to the appropriate requirements of the MANUAL TESTING part of this chart.
9	Press the START button.
	A. Signaling (SIG) Test
	Note 1: Signaling test assumes 900-ohm impedance for 2-wire channel units and 600-ohm impedance for 4-wire channel units when TERMINATION AUTO button is selected. Impedances other than those must be selected by the appropriate TERMINATION button.
	Note 2: The ATAU will not identify special service channel units using the signaling test. Hence, this test will fail if run on a special service channel unit. If the signaling test fails, or is not run, the ATAU automatically sets the signaling highways for most CU types to enable performance of subsequent VF tests. All CU types not listed on the ATAU front panel will fail the SIG test. The ATAU cannot self-correct for the following CU types (operator must set the TX LEVEL switches before pressing STEP): (1) 2WFXO (D2 signaling) */1/0; (2) 2WFXS (D3 signaling) */0/1; (3) 2WFXS/EVF, 2WPLAR, and 2WDX (set BSY switch to ON). Once this is done, the user may proceed with the remaining tests by pressing the STEP button.
	Requirement: CHAN TYP LED corresponding to the actual CUUT type turns on and SIG LED does not flash.

CHART 1 (Cont)

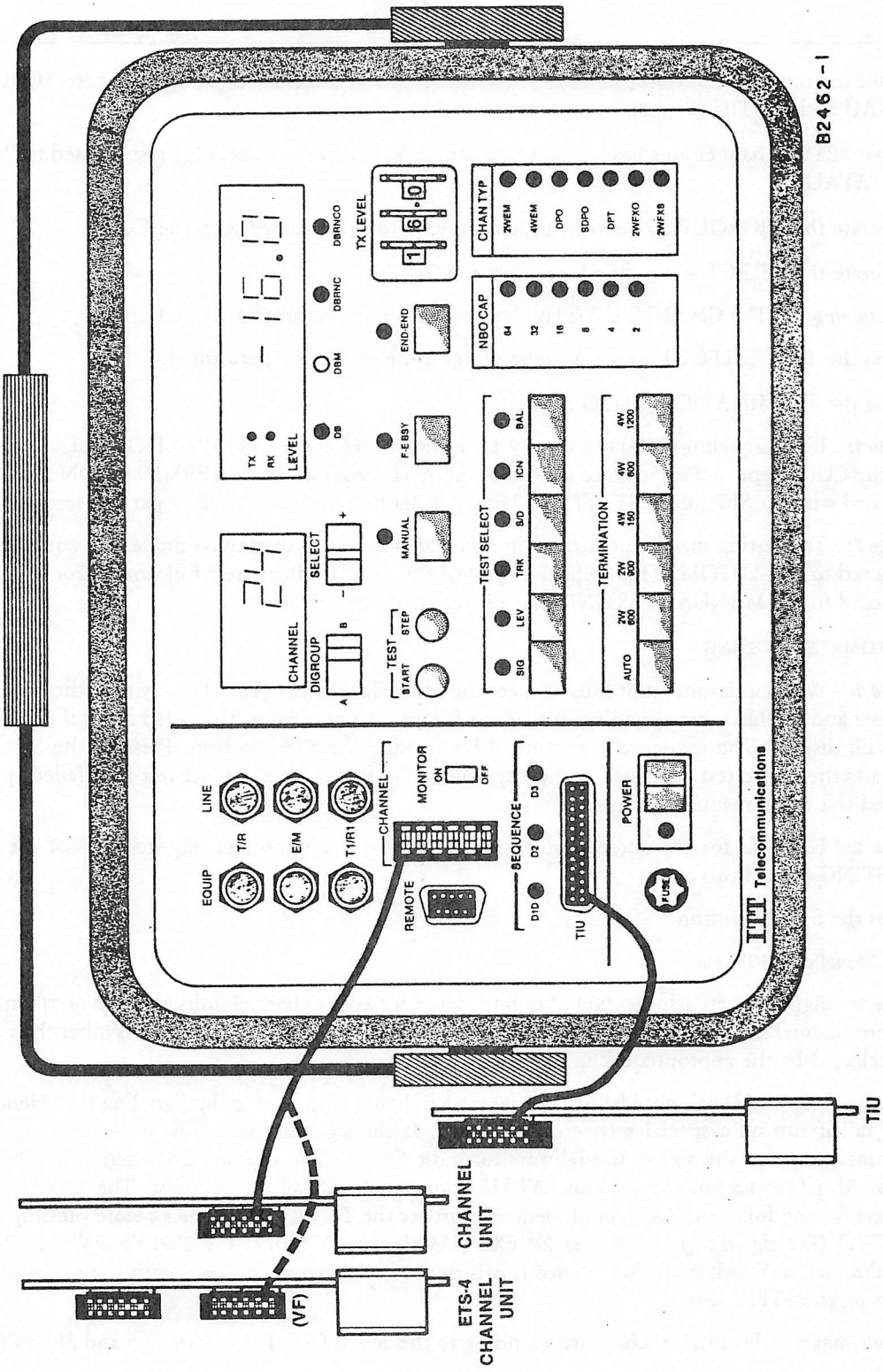


Fig. 1—ATAU Test Connections

CHART 1 (Cont)

STEP	PROCEDURE

B. VF Level (LEV) Test

Note 1: During the level test, the receive VF level is automatically displayed with the RX LED on. The STEP button must be pressed in order to display the transmit VF level (TX LED on), and pressed again to proceed to the next test. There are not TFLs for this test.

Note 2: The levels displayed will differ from the standard levels of Table C if the [TX] or [RX] prescription level and OWL options on the CUUT are selected. Compensation must be made for the options to determine whether the CUUT meets the requirement.

Requirement: As specified in Table C.

TABLE C

NOMINAL TRANSMIT AND RECEIVE LEVELS

DIRECTION	2-WIRE CU	4-WIRE CU
Receive	−3.0 ±0.3 dBm	+7.0 ±0.3 dBm
Transmit	0 ±0.3 dBm	−16.0 ±0.3 dBm

C. Tracking (TRK) Test

Note: If the requirement is not met, the failed test result at which this occurs is displayed on the LEVEL display.

Requirement: ATAU proceeds through test and TRK LED does not flash.

D. Signal-to-Distortion (S/D) Test

Note: If the requirement is not met, the failed test result at which this occurs is displayed on the LEVEL display.

Requirement: ATAU proceeds through test and S/D LED does not flash.

E. Idle Channel Noise (ICN) Test

Note: If the requirement is not met, the failed test result at which this occurs is displayed on the LEVEL display.

Requirement: ATAU proceeds through test and ICN LED does not flash.

10 Remove all test connections, turn POWER switch to off position, and disconnect power cord from outlet and ATAU.

CHART 1 (Cont)

STEP	PROCEDURE

MANUAL TESTING

11 Press the MANUAL button.

Requirement: MANUAL LED turns on.

Note: The following procedure assumes that all tests have been selected. If this is not the case, the procedure should be modified accordingly.

A. Signaling (SIG) Test

12 Press the START button.

Note 1: Signaling test assumes 900-ohm impedance for 2-wire channel units and 600-ohm impedance for 4-wire channel units when TERMINATION AUTO button is selected. Impedances other than those must be selected by the appropriate TERMINATION button.

Note 2: The ATAU will not identify special service channel units using the signaling test. Hence, this test will fail if run on a special service channel unit. If the signaling test fails, or is not run, the ATAU automatically sets the signaling highways for most CU types to enable performance of subsequent VF tests. All CU types not listed on the ATAU front panel will fail the SIG test. The ATAU cannot self-correct for the following CU types (operator must set the TX LEVEL switches before pressing STEP): (1) 2WFXO (D2 signaling) */1/0; (2) 2WFXS (D3 signaling) */0/1; (3) 2WFXS/EVF, 2WPLAR, and 2WDX (set BSY switch to ON). Once this is done, the user may proceed with the remaining tests by pressing the STEP button.

Requirement: CHAN TYP LED corresponding to the actual CUUT type turns on.

B. Level (LEV) Test

13 Press the STEP button.

Note: The levels displayed will differ from the standard levels of Tables D and E if the [TX] or [RX] prescription level and OWL options on the CUUT are selected. Compensation must be made for the options to determine whether the CUUT meets the requirements.

Requirement: As specified in Table D.

TABLE D

NOMINAL RECEIVE LEVELS

2-WIRE CU	4-WIRE CU
−3.0 ±0.3 dBm	+7.0 ±0.3 dBm

CHART 1 (Cont)

STEP	PROCEDURE

14 Press the STEP button to display the transmit level.

Requirement: As specified in Table E.

TABLE E

NOMINAL TRANSMIT LEVELS

2-WIRE CU	4-WIRE CU
0 ±0.3 dBm	−16.0 ±0.3 dBm

C. Tracking (TRK) Test

15 Press the STEP button to proceed to the next test. The STEP button must be pressed for each input level for both receive and transmit.

Requirement: As specified in Table F for receive and in Table G for transmit when compensated for prescription level settings.

TABLE F

RECEIVE TRACKING LEVELS

LEVEL IN (dBm0)	LEVEL OUT (dBm)*	
	2-WIRE CU	4-WIRE CU
0.0	−2.7 to −3.3	+6.7 to +7.3
−9.96	−12.7 to −13.3	−2.7 to −3.3
−19.93	−22.6 to −23.2	−12.6 to −13.2
−30.10	−32.8 to −33.4	−22.8 to −23.4
−39.89	−42.4 to −43.4	−32.4 to −33.4

*For nominal factory-set levels per Table A.

TABLE G

TRANSMIT TRACKING LEVELS

LEVEL IN (dBm0)	LEVEL OUT (dBm)*	
	2-WIRE CU	4-WIRE CU
0.0	0.0 ±0.3	−16.0 ±0.3
−10.0	−10.0 ±0.3	−26.0 ±0.3
−20.0	−20.0 ±0.3	−36.0 ±0.3
−30.0	−30.0 ±0.3	−46.0 ±0.3
−40.0	−40.0 ±0.5	−56.0 ±0.5

*For nominal factory-set levels per Table A.

CHART 1 (Cont)

STEP	PROCEDURE

D. Signal-to-Distortion (S/D) Test

16 Press the STEP button to proceed to the next test. The STEP button must be pressed for each input level for both receive and transmit.

Requirement: As specified in Table H for receive and in Table I for transmit.

TABLE H

RECEIVE SIGNAL-TO-DISTORTION RATIOS

RX LEVEL (dBm0)	MIN. S/D RATIO (dB)
0.0	35
−9.96	35
−19.93	35
−30.10	35
−39.89	29

TABLE I

TRANSMIT SIGNAL-TO-DISTORTION RATIOS

TX LEVEL (dBm0)	MIN. S/D RATIO (dB)
0.0	34
−10.0	34
−20.0	34
−30.0	34
−40.0	28

Note: Signal-to-distortion ratios listed include 1.0-dB allowance for ATAU noise contribution.

E. Idle Channel Noise (ICN) Test

17 Press the STEP button to proceed to the next test. The receive level is displayed first.

Requirement: 16 dBrnc0 (includes 1.0-dB allowance for ATAU noise contribution).

18 Press the STEP button to proceed to the transmit portion of the test.

Requirement: 22 dBrnc0 (includes 2.0-dB allowance for ATAU noise contribution).

CHART 1 (Cont)

STEP	PROCEDURE
	F. Balance (BAL) Test
19	Press the STEP button to proceed to the next test.
	Note: Several of the NBO CAP LEDs flash momentarily during the performance of this test. When the correct network build-out (NBO) capacitance has been determined, the LEDs corresponding to the options that should be selected on the CUUT are turned on. Also, the CUUT transhybrid loss is displayed on the LEVEL display.
	Requirement: NBO CAP LEDs turn on and LEVEL display indicates 28-dB minimum.
20	Verify that NBO options on CUUT are set the same as indicated on ATAU.
21	Decrease NBO capacitance on CUUT by 0.002 uF. If transhybrid loss improves (increases), leave options set and proceed to Step 23; otherwise, return options to previous setting and proceed to Step 22.
22	Increase NBO capacitance on CUUT by 0.002 uF. If transhybrid loss improves (increases), leave options set; otherwise, return options to previous setting.
23	Remove all test connections, turn POWER switch to off position, and disconnect power cord from outlet and ATAU.

CHART 2

LOOPED TESTING USING STANDARD TEST EQUIPMENT

APPARATUS:

1—Transmission test set (Northeast TTS-44, Telecommunications Technology TTI-1122, or equivalent)

2 or 3—Shorting plugs (supplied with equipment)

2—Card jack/310 adapter cord (ITT Part No. 600397-540-003)

600- or 900-ohm + 2.16 uF termination

STEP	PROCEDURE
	Note 1: This Chart provides procedures for performing looped terminal testing when the ATAU is not available. The procedures in this chart use standard (customer-supplied) test equipment. Due to the numerous types of test equipment available, ITT makes no attempt to inform the user of specific test equipment control settings or interconnection. Detailed information on specific pieces of test equipment should be obtained from the manufacturer's operating manual.

CHART 2 (Cont)

STEP	PROCEDURE

Note 2: The tests in this chart must be performed with the multiplex terminal looped and in the shifted mode.

Note 3: Card jack/310 adapter cord (ITT Part No. 600397-540-003), which is used in these tests, is shown in Fig. 2. For clarity, a simplified representation of the cord is used in the test setup figures. The adapter cord mounts on the front of the power converter unit (PCU) by positioning unit over PCU center screw.

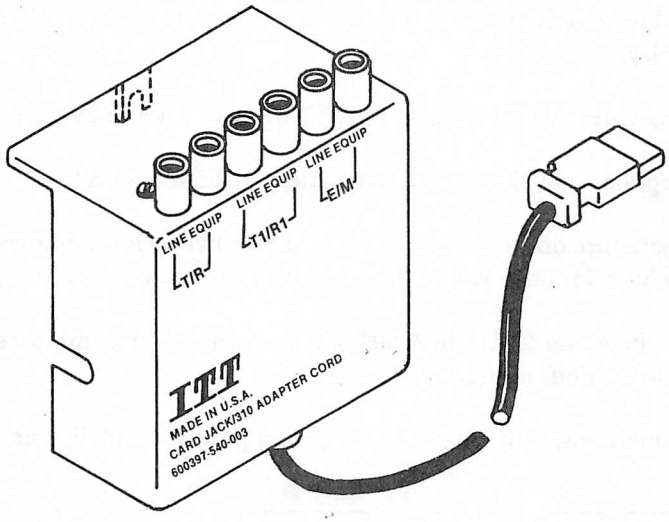


Fig. 2—Card Jack/310 Adapter Cord

Note 4: The BSY switch on a DPT, 2WFXS/EVF, 2WPLAR, 2WFXO, or 2WFXO/LS channel unit must be in the BSY position to ensure correct test results on all tests in this chart.

Note 5: Table J lists the impedances of the D448 channel units so that the test equipment may be set to the proper input and output impedances and so that proper terminations may be selected when required.

Note 6: ETS-4 channel unit has two splitting card jacks. The lower jack is for VF access.

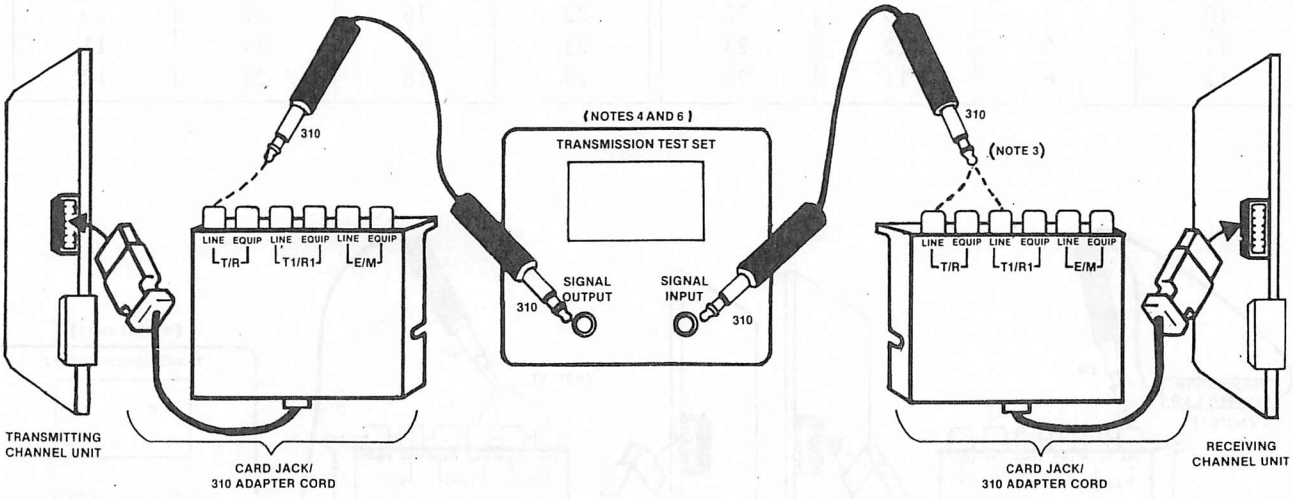
TABLE J

CHANNEL UNIT IMPEDANCES

IMPEDANCE	CHANNEL UNITS
600 ohms + 2.16 uF	2WEM6, 2WEM6A, DPO6, SDPO6, DPT6, DPT6I, 2WFXO6, 2WFXS6
900 ohms + 2.16 uF	2WEM9, 2WEM9A, DPO9, SDPO9, DPT9, DPT9I, 2WFXO9, 2WFXS9, 2WDX, 2WPLAR
600 ohms	4WEM, 4WTO, 4WTO/SF, 4WPLR, 4WTDM, 4WEVF, 4WSF, ETS-4
150/600/1200 ohms (Impedance Determined by Option Selection)	4WETO, 4WFXO/VF, 4WFXO, 4WFXS/VF, 4WFXS, 4WDX/VF, 4WDX

CHART 2 (Cont)

STEP	PROCEDURE
1	Insert a shorting plug into the FTP test points on the trunk processor and alarm (TPA) unit associated with the digroup under test (in Mode 1 operation, there is only one TPA unit).
2	Press the LOOP button on the TPA unit.
3	Insert a shorting plug into the SHIFT test points on the transmit logic unit (TLU) associated with the digroup under test.
4	Using Fig. 3 through 6 and the manufacturer's instructions for specific test equipment control settings and interconnections, perform the desired tests.
5	After testing, disconnect all test equipment and remove the shorting plugs from the TPA unit and the TLU.



NOTES:

1. REFER TO TABLE K FOR SHIFTED MODE TRANSMITTING-TO-RECEIVING CHANNEL CROSS-REFERENCE CHART.
2. REQUIREMENTS FOR ALL TESTS ARE BASED ON THE NOMINAL FACTORY-SET LEVELS PER TABLE A. REQUIREMENTS SHOULD BE MODIFIED FOR OTHER LEVEL SETTINGS.
3. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
4. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE J FOR CU IMPEDANCES.
5. THE RECOMMENDED TRANSMIT FREQUENCY FOR THESE TESTS IS 1004 TO 1020 Hz.
6. THE SIGNAL-TO-DISTORTION TEST REQUIRES A NOTCH FILTER CENTERED ON THE TRANSMITTING FREQUENCY, AND DISTORTION IS TO BE MEASURED USING A C-MESSAGE WEIGHTED FILTER.

TRACKING TEST

2-WIRE CU		4-WIRE CU	
TRANSMIT LEVEL (dBm)	RECEIVE LEVEL (dBm)	TRANSMIT LEVEL (dBm)	RECEIVE LEVEL (dBm)
0.0	−3.0 ±0.5	−16.0	+7.0 ±0.5
−10.0	−13.0 ±0.5	−26.0	−3.0 ±0.5
−20.0	−23.0 ±0.5	−36.0	−13.0 ±0.5
−30.0	−33.0 ±0.5	−46.0	−23.0 ±0.5
−40.0	−43.0 ±1.0	−56.0	−33.0 ±1.0

SIGNAL-TO-DISTORTION TEST

TRANSMIT LEVEL (dBm)		MAX. DISTORTION LEVEL (dBrnc)	
2-WIRE	4-WIRE	2-WIRE	4-WIRE
0.0	−16.0	54	64
−10.0	−26.0	44	54
−20.0	−36.0	34	44
−30.0	−46.0	24	34
−40.0	−56.0	20	30

VF LEVEL TEST

CU TYPE	TRANSMIT LEVEL	RECEIVE LEVEL
2-WIRE	0 ±0.25 dBm	−3 ±0.25 dBm
4-WIRE	−16 ±0.25 dBm	+7 ±0.25 dBm

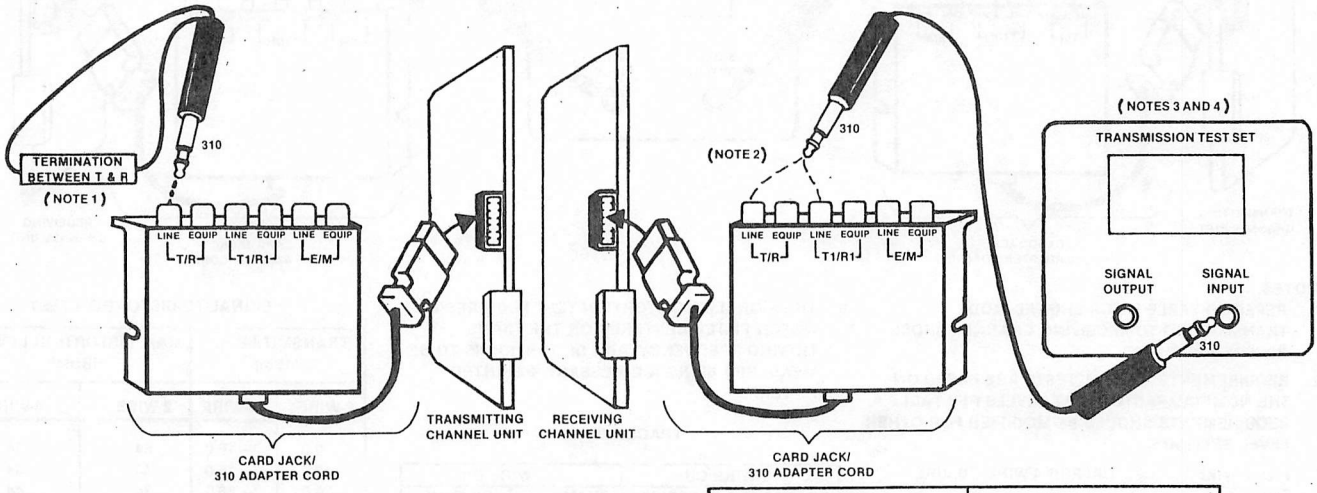
Fig. 3—Typical Test Setup for VF Level, Tracking, and Signal-to-Distortion Tests

CHART 2 (Cont)

TABLE K

SHIFTED MODE, TRANSMITTING-TO-RECEIVING CHANNEL CROSS-REFERENCE CHART

TRANSMIT CHANNEL	RECEIVE CHANNEL			TRANSMIT CHANNEL	RECEIVE CHANNEL		
	D1D OPERATION	D2 OPERATION	D3 OPERATION		D1D OPERATION	D2 OPERATION	D3 OPERATION
1	7	2	13	13	19	14	1
2	8	1	14	14	20	13	2
3	9	4	15	15	21	16	3
4	10	3	16	16	22	15	4
5	11	6	17	17	23	18	5
6	12	5	18	18	24	17	6
7	1	8	19	19	13	20	7
8	2	7	20	20	14	19	8
9	3	10	21	21	15	22	9
10	4	9	22	22	16	21	10
11	5	12	23	23	17	24	11
12	6	11	24	24	18	23	12



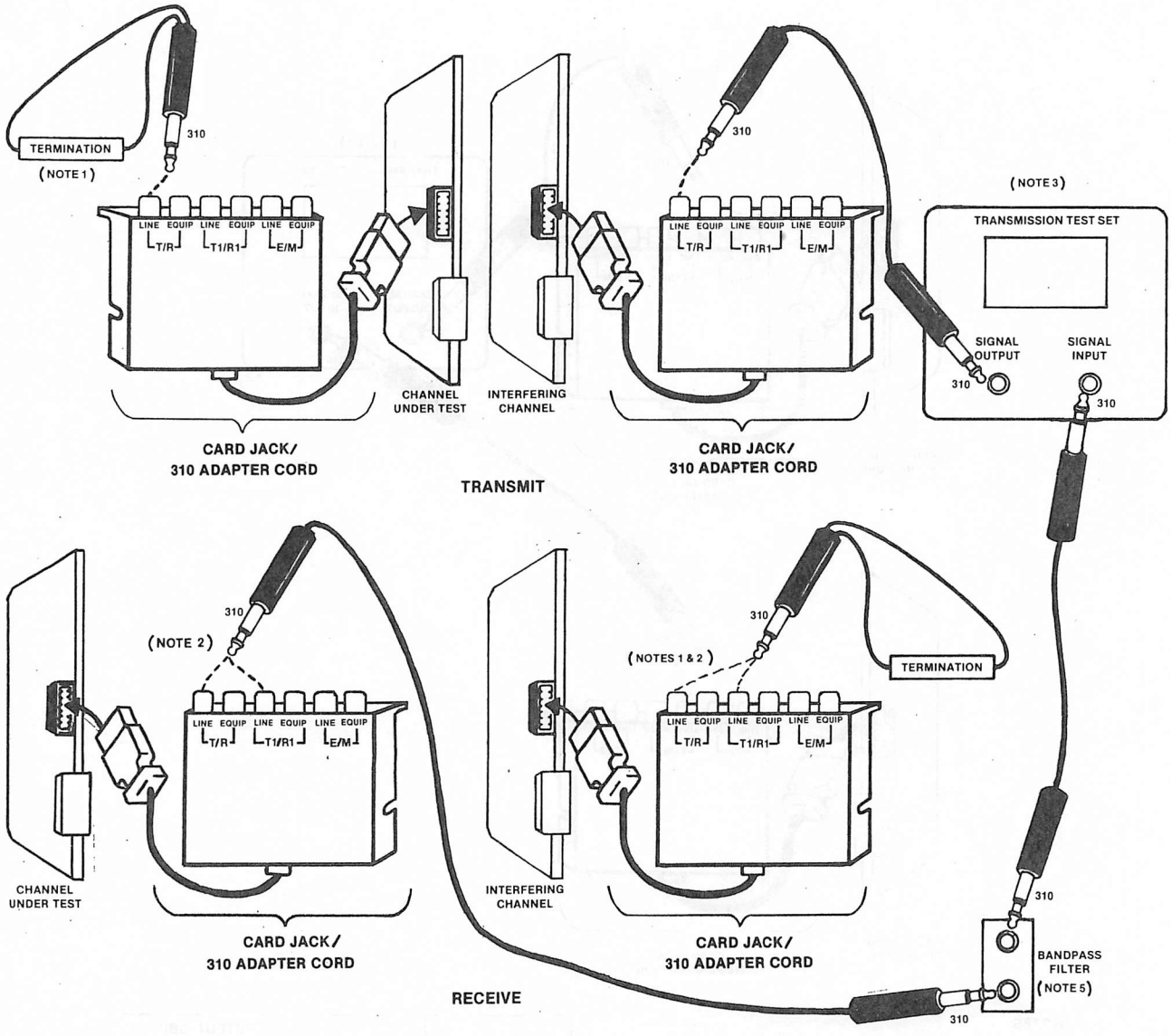
NOTES:
1. TRANSMITTING CU MUST BE TERMINATED. (REFER TO TABLE J.)
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE J FOR CU IMPEDANCES.
4. NOISE MEASURING SET OR TRANSMISSION TEST SET MUST HAVE C-MESSAGE WEIGHTED FILTER.

CU TYPE	MAX. NOISE LEVEL (dBrnc)*
2-WIRE (NOMINAL RECEIVE VF LEVEL −3 dBm)	20
4-WIRE (NOMINAL RECEIVE VF LEVEL +7 dBm)	30

*BASED ON NOMINAL FACTORY-SET LEVELS PER TABLE A.

Fig. 4—Typical Test Setup for Idle Channel Noise Test

CHART 2 (Cont)



NOTES:

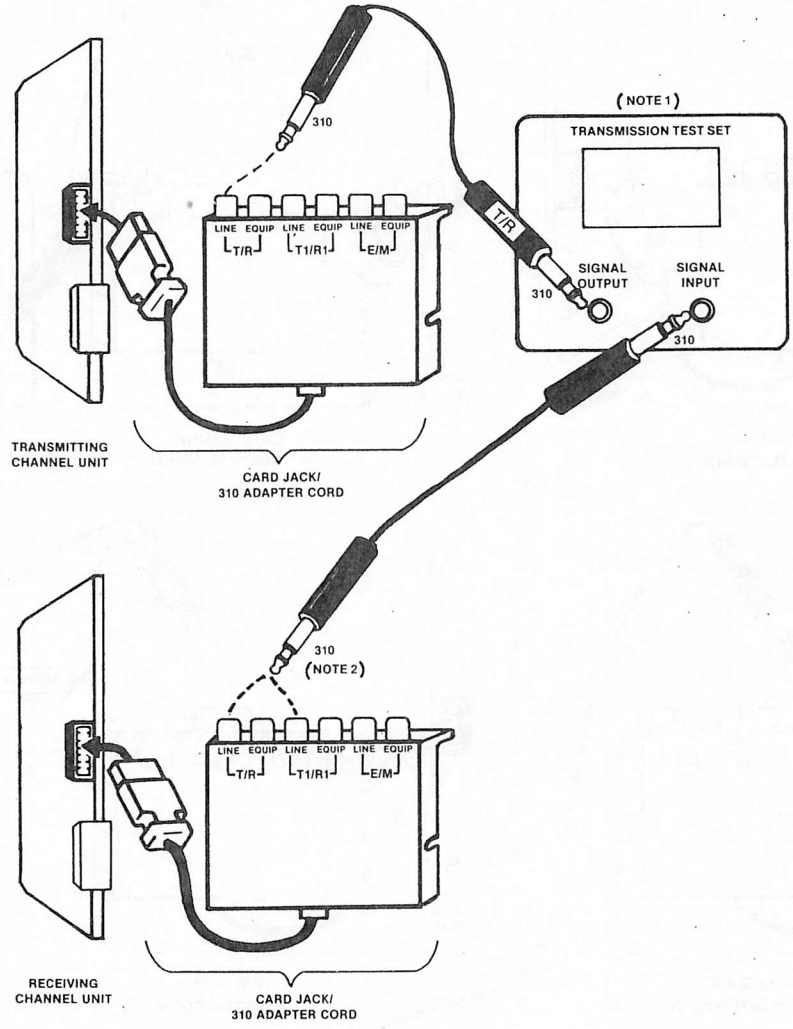
1. BOTH INTERFERING CHANNEL (RECEIVE) AND CHANNEL UNDER TEST (TRANSMIT) MUST BE TERMINATED. (REFER TO TABLE J.)
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE J FOR CU IMPEDANCES.
4. TRANSMITTING LEVEL —
   2-WIRE CU: 0.0 dBm
   4-WIRE CU: −16.0 dBm
   RECOMMENDED TRANSMITTING FREQUENCY: 1004 TO 1020 Hz.
5. THE RECEIVE END MUST HAVE A NARROW BANDPASS FILTER CENTERED ON THE TRANSMITTING FREQUENCY.
6. IN THE D448 MULTIPLEX TERMINAL, CROSSTALK HAS BEEN REDUCED FROM AN ELECTRICAL (COMMON EQUIPMENT CHARACTERISTIC) PLUS PHYSICAL SOURCE TO PHYSICAL ONLY. THIS OPTIONAL TEST NEED ONLY BE PERFORMED ON ONE CHANNEL PER DIGROUP. THE MOST LIKELY CHANNEL UNITS RESPONSIBLE FOR CROSSTALK INTERFERENCE ARE THOSE PHYSICALLY ADJACENT TO THE CHANNEL UNDER TEST.

CU TYPE	INTERFERENCE LEVEL*
2-WIRE CU	−68 dBm OR LESS (for example −70)
4-WIRE CU	−58 dBm OR LESS (for example −60)

*BASED ON NOMINAL FACTORY-SET LEVELS PER TABLE A.

Fig. 5—Typical Test Setup for Crosstalk Test

CHART 2 (Cont)



NOTES:

1. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE J FOR CU IMPEDANCES.
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. TRANSMITTING LEVEL —
   2-WIRE CU: 0.0 dBm
   4-WIRE CU: – 16.0 dBm
   OR OTHER DEPENDING ON PRESCRIPTION LEVEL SETTINGS.

INPUT FREQUENCY (Hz)	OUTPUT (dB)*		
	4-WIRE	2-WIRE 900 OHMS	2-WIRE 600 OHMS
300 to 600	—	—	+ 1.0 to – 3.0
300 to 3000	+ 0.3 to – 0.3	+ 0.5 to – 1.0	—
600 to 3000	—	—	+ 1.0 to – 1.0
3200	+ 0.15 to – 1.5	+ 0.25 to – 1.5	+ 1.0 to – 1.5
3400	0 to – 3.0	0 to – 3.0	+ 1.0 to – 3.0

*Referenced to 1020 Hz.

Fig. 6—Typical Test Setup for Frequency Response Test